Tipularia

A BOTANICAL MAGAZINE

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Photograph from Hugh and Carol Nourse

***Elliottia racemosa*, Georgia plume**

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Membership

The Georgia Botanical Society is open to all persons interested in the botany of Georgia. Annual dues: individual or family, $20; group, $25; Student, $5. Send address and check payable to Georgia Botanical Society to **Teresa Ware.** Members receive Tipularia without extra charge. Persons wishing only to receive the magazine may become Tipularia associates for $10 a year. Single copies, when available, may be ordered from Sally Emory, 7575 Rico Rd., Palmetto, GA 30268 (1991 and before: $5; 1992 and after: $10).

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Elliottia racemosa, Georgia plume, photograph from Hugh and Carol Nourse

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The Georgia Plant Conservation Alliance

A Network for Conservation and Collaboration

By James M. Affolter and Jennifer F. Ceska

A little more than three years ago, representatives from a diverse group of organizations agreed to form a new statewide organization, the Georgia Plant Conservation Alliance (GPCA). The driving concept behind the new Alliance was to bring together institutions from around the state to develop and implement a cooperative agenda of plant conservation programs. Our hope was that, by sharing our individual resources and fields of expertise, we could collectively begin to reverse the patterns of extinction and destruction of critical habitat that are overwhelming our native flora. We also hoped to cut through some red tape and bureaucratic inertia in the process.

For years, numerous organizations and individuals across the state have been working to gather information concerning Georgia's rare plants and to act to ensure their survival. In July, 1995, organizations that had been working together informally for more than a decade formed this conservation network in an effort to limit duplication of projects and, more importantly, to pool resources. We organized our activities around specific projects, chosen to represent a range of research and management approaches. We also adopted what is known as an "integrated conservation strategy," combining on-site and off-site activities and utilizing a range of technologies drawn from ecological, genetic and horticultural sciences. Each project involves a team of participants – botanical garden staff, land managers, state and federal botanists and university scientists – working side by side. The informal network of collaborators has grown to include private landowners, volunteers and conservation professionals in Georgia and adjacent states.

GPCA Charter Members

Atlanta Botanical Garden
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Callaway Gardens
706-663-5020

Georgia Natural Heritage Program
706-557-3032

The Nature Conservancy of Georgia
404-873-6946

The State Botanical Garden of Georgia
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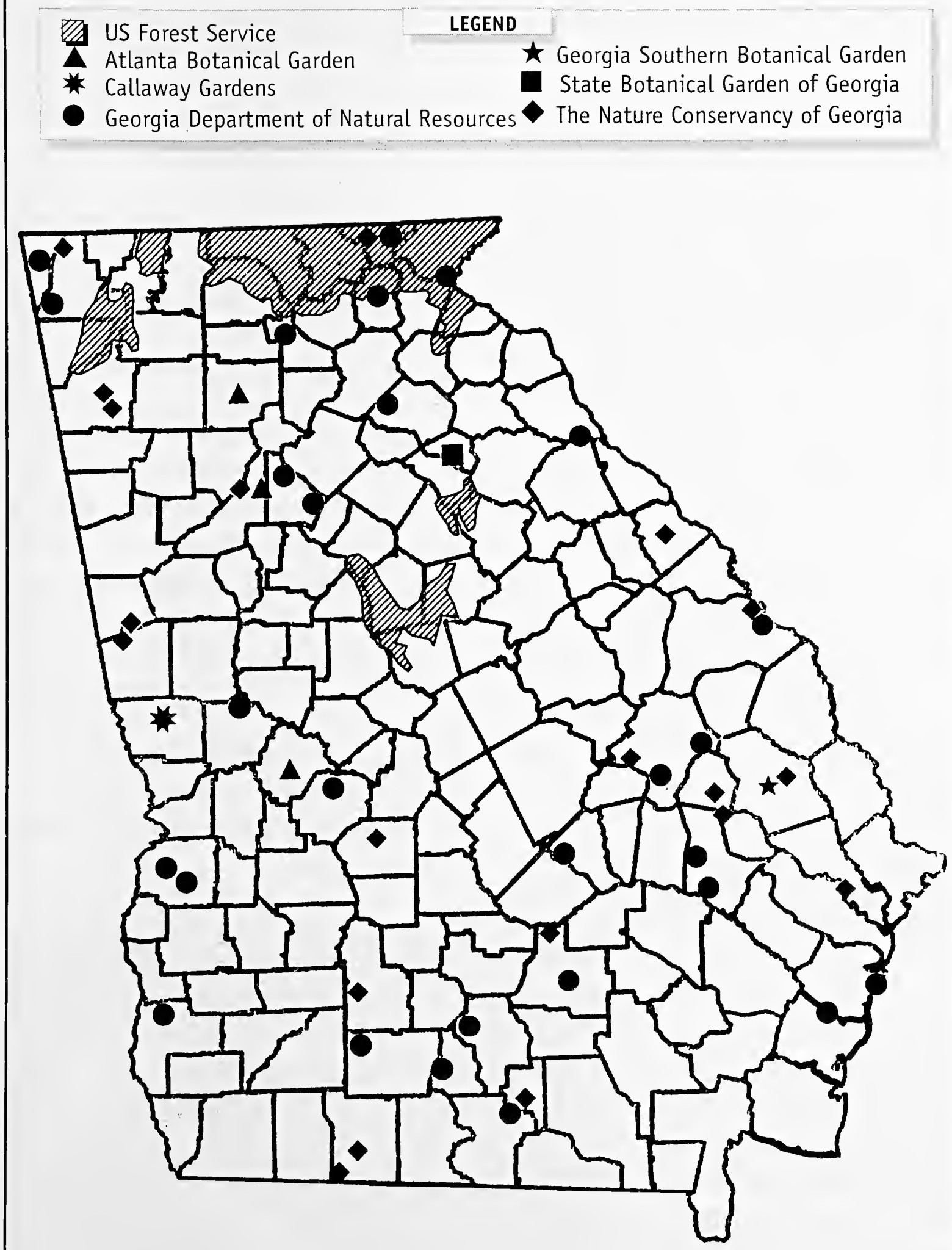


Georgia Department of Natural Resources
Wildlife Resources Division
Georgia Natural Heritage Program
March 1996

GPCA, Its Members and Its Missions

The Alliance includes three botanical gardens, government agencies, non-profit environmental organizations and the University of Georgia (see box on previous page). It is one of the first coalitions of its kind and is already being studied by neighboring states and national conservation organizations as a model for their own programs. The task of the Alliance is to coordinate and carry out research, education and conservation programs concerning Georgia's endangered plants. As a group, members of the Alliance can draw upon resources that no individual organization in the state could possibly match. Collectively, GPCA member organizations own or manage research facilities and nature reserves across Georgia (see map). Our combined professional expertise embraces the entire field of plant conservation, from laboratory research to natural areas management and conservation education.

The second major commitment of the Alliance is to highlight Georgia's rich natural heritage and its present state of endangerment. This effort draws upon one of the greatest resources of the Alliance: a built-in audience of hundreds of thousands of people who visit and support its member institutions. GPCA participants include skilled educators experienced in bringing the subject of plant conservation to life though in-school programs, garden exhibits, publications, field trips and electronic media. Establishment of the Georgia Endangered Plant Stewardship Network, described later, is one of the Alliance's most exciting accomplishments.

Need for Plant Conservation in Georgia

Just how urgent is the need for plant conservation in the United States in general, and in Georgia in particular? After all, we hear frequent news reports about disappearing tropical rainforests and endangered owls, but when was the last time the network news flashed a picture of an endangered shrub from the southeast on the screen? It's not surprising that most people are more interested in soft, furry endangered animals than in rare plants (botanists have been losing that public relations battle for decades), but it is remarkable that many people in the United States who are genuinely concerned about tropical forests are unaware of the extinction clock ticking in their own backyards.

Photo by Jennifer Ceska

Tom Patrick replanting *Sarracenia purpurea* during spring, 1997

Commercial development, expansion of metropolitan areas, immigration, the Olympics – all these high-profile activities reflect the rapid growth taking place in Georgia. But one of the downsides associated with this changing human landscape has been the gradual erosion of the number of native plant species that occur in our state, as well as the size and health of their individual populations. This is part of a much larger pattern of species loss occurring across the country. A national survey of botanists and horticulturists completed in 1988 by the Center for Plant Conservation concluded that 680 plant species in the United States could become extinct by the year 2000. A recent report by The Nature Conservancy considers nearly one-third of the nation's estimated 15,495 species of flowering plants to be of conservation concern.

First Steps

We are fortunate in having an excellent and up-to-date reference for Georgia's rare plants, *Protected Plants of Georgia*, published by the Georgia Natural Heritage Program in 1995. This manual provides detailed information concerning 103 of the most threatened plants in the state, those that are formally protected by the Georgia Wildflower Preservation Act of 1973. This is only a "short list" however; the Georgia Natural Heritage Program database tracks approximately 609 Georgia plants that are of conservation concern. It is becoming more apparent all the time that cooperation between institutions charged with the responsibility of conserving species is a fundamentally important strategy for plant conservation.

GPCA was created to target this issue, and one of our first tasks was to identify four projects that addressed top priority plant conservation needs in the state. Since one of the strengths of the Alliance is the diverse expertise of the participants, we chose projects that combine research (*e.g.*, propagation methods, genetic surveys) with on- and off-site management activities (*e.g.*, establishment of cultivated germplasm collections, controlled burning of natural habitats to discourage overstory growth). These long-term projects illustrate the depth of collaboration in GPCA. We emphasize projects to stay "project driven." Beyond investigating these projects, we work to distribute our results to land managers, scientists and educators through direct correspondence and through publications.

GPCA Research Projects

1. Safeguarding *Torreya taxifolia*, the Florida Torreya

Hank Bruno
Trails Manager, Callaway Gardens
GPCA Torreya Committee Chair

The Florida Torreya (*Torreya taxifolia*) is one of the most critically endangered trees in the United States. It is related to the yew of the Pacific Northwest (*Taxus brevifolia*), from which we get taxol, a drug used to treat cancer. A chronic fungal disease threatens the survival of Florida Torreya in the wild. Part of the strategy to preserve this tree is to develop a number of carefully documented

off-site collections through horticultural propagation, and to safeguard documented replicates of these trees at GPCA institution sites.

The Atlanta Botanical Garden has a complete set of these documented trees as part of a collaborative project with the Center for Plant Conservation. These trees have been replicated, and sets of trees will be planted by population on lands held by GPCA members for long-term safeguarding. In March, 1997, the first set of these trees went out; a set representing the single Georgia population of Florida Torreya was planted at Smithgall Woods/Dukes Creek Conservation Area near Cleveland, Georgia. Perhaps when the disease is brought under control, plants propagated from these safeguarding collections can be reintroduced to their original habitat.

2. Recovery of *Elliottia racemosa*, the Georgia Plume

Jonathan Streich
Director of Stewardship,
The Nature Conservancy of Georgia
GPCA Elliottia Committee Chair

The Georgia plume is a rare and beautiful shrub endemic to Georgia. There is concern that this species is not reproducing sexually in the wild. Although seeds are produced by mature trees, seedlings have not been confirmed in natural populations for approximately 50 years. GPCA is working to reverse this trend by habitat management and study of the propagation and breeding system of this Georgia species. Projects include seed viability testing, seed propagation, comparison of habitat management methods to stimulate reproduction, genetic surveys to document the amount and distribution of genetic diversity in the species, breeding system studies and cultivation studies.

GPCA has successfully propagated seeds from three populations using several methods which will help us determine the factors or conditions seeds need to germinate in the wild. The genetic survey is being conducted by Drs. Mary Jo Godt and Jim Hamrick of the University of Georgia and is sponsored by a grant from the Georgia Non-game Wildlife Small Grants Program. (We would like to thank Jay Averett, John Bozeman, Elon Flack and Georgia Bot Soccers Hugh Nourse, Carol Nourse, George Rogers and Albie Smith for their assistance with this project.)

3. Restoration of Pitcherplant Bogs

Ron Determann
Fuqua Conservatory Superintendent,
Atlanta Botanical Garden
GPCA Bog Committee Chair

GPCA has tackled a large project involving the restoring of and the implementing of management plans for nearly a dozen bog sites in Georgia. We are documenting the efforts at these sites and plan to produce a practical manual, *Pitcherplant Bog Conservation in Georgia, A Manual for Restoration and Management,* to summarize and distribute information for land managers. Sites include both mountain bogs (the rarest habitat of the Appalachian Mountains) and coastal plain bogs (the most species-rich of all North American habitats).

Projects include comparison of

restoration and management techniques (*e.g.*, fire in multiple seasons, "hack, haul and scorch" techniques to curb woody species regrowth, organic damming), propagation of bog species, safeguarding *ex-situ* at botanical gardens and *in-situ* at wild sites, genetic surveying of wild and safeguarded plant material, reintroduction to bolster declining populations of key species, photo documentation and detailed habitat monitoring. Our restoration and management techniques are purposefully low-tech so that they can be easily adapted by land managers and private landowners while still producing significant benefits for the bog habitat. Our monitoring approaches are more technical, including a new pan-head photography procedure which allows us to recreate on computer detailed 360° pan photos of bog study sites. Funding for this long-term project has come in part from the Turner Foundation, Inc. and the National Fish and Wildlife Foundation.

4. Historic Species Search Project

Tom Patrick
Botanist, Georgia Natural Heritage Program
GPCA Search Committee Chair

Historic species are plants that have been documented or reliably reported in a specific area, but which have not been observed there for at least 20 years. This project was developed to relocate extant populations of rare plants not seen in the wild since about 1975 or before.

Working with the Georgia Natural Heritage Program and the University of Georgia Herbarium, Jennifer Cruse (GPCA 1997 summer intern) compiled individual fact sheets to produce a field guide for GPCA's first search manual on the Blue Ridge and Ridge and Valley Physiographic Provinces of Georgia. The manuals include identification notes, line drawings and brief histories of the discoveries. Once the manuals are published, it is hoped that members of the public and botany students of all types will take

Elliottia racemosa **seedling propagated by GPCA horticulture team using a new smoke treatment**

Photo from Hugh and Carol Nourse

on the challenge to relocate these "lost species" within Georgia. Examples of historic species once reported from the mountains are wild bleeding hearts (*Dicentra eximia*), witch hobble or hobblebush (*Viburnum lantanoides*) and yellow Clinton's lily (*Clintonia borealis*).

The GEPSN Education Project

The Georgia Endangered Plant Stewardship Network (GEPSN) mentioned previously is GPCA's premier education project, developed by Anne Shenk and Jennifer Ceska of the State Botanical Garden of Georgia. Launched in 1996, the GEPSN project is an in-school plant propagation project in which students become stewards of the environment by propagating and caring for native species (including state protected plants) both in their classroom and on their school site.

To participate, teachers first attend a training workshop entitled "The Green Plant Blues." Four GEPSN workshops have been held to date, with approximately 90 teachers trained and 26 outdoor classrooms and bogs built. Workshops prepare participants to teach about Georgia's endangered species, conservation issues, propagation and related science inquiry activities.

The workshops also provide an opportunity for teachers to meet and learn from GPCA scientists. We plan to offer several workshops a year at host sites around the state. In 1999 we will offer our first workshop via the distance learning network to give teachers throughout the state access to this program. The GEPSN project has its own web site (www.uga.edu/BotGarden/GEPSN) and newsletter (The Green Plant Blues News). Funding has been provided by grants from the Eisenhower Plan for the Advancement of Math and Science and the Turner Foundation, Inc.

Although teachers can apply for

Photo from Hugh and Carol Nourse

Children of Athens Montessori school with Anne Shenk, planting their bog

seeds of several species of protected plants of Georgia for their outdoor classroom, including Ocmulgee skullcap (*Scutellaria ocmulgee*) and Atlantic white cedar (*Chamaecyparis thyoides*), pitcherplants and bogs are being featured initially in the project. Their carnivory is a useful teaching tool, allowing interpretation of plant/animal interactions and loss of habitat due to multiple complicated factors. Plant material of these species is available for their propagation in schools thanks to the Atlanta Botanical Garden (ABG).

Ron Determann, at ABG, provided technical expertise to develop pitcherplant bogs on school sites, which has been a very exciting and successful element of the project. Data classes collect in their outdoor classrooms (pollinators, bloom time, seed counts) may assist scientists studying Georgia's endangered plants. Future plans for the GEPSN project include adding a second phase to the outdoor classroom, featuring endangered plants of the rock outcrop pools.

GPCA Settling In and Gaining Support

One of the most pleasant surprises during our first three years has been how smoothly the gears of this new organization have meshed. In part this is due to the fact that many GPCA participants have been working together on smaller projects for years; pieces of the network were already in existence. We also made the conscious decision to stay lean and grow slowly. By focusing on specific projects, we hoped to avoid creating an administrative marshmallow that would collapse upon itself when initial funds or enthusiasm ran out. Finally, the timing was right: Georgia needs a coordinated effort to protect its endangered flora, and GPCA member institutions saw the wisdom of joining forces in the effort.

We anticipate GPCA will grow as we develop new partnerships and welcome additional specialists to our conservation programs. Faculty members, postdoctoral researchers and staff at the University of Georgia are already participating, and more students will be encouraged to become involved in rare plant research and conservation education programs. The opportunity to work with prominent conservation organizations in Georgia and the exposure to some of the many different approaches to rare plant conservation will provide unique educational experiences for students. We welcome cooperators and hope this article explains our mission. T

For more information about the Georgia Plant Conservation Alliance (GPCA), contact your local GPCA institution or the following staff of the State Botanical Garden:
Jim Affolter (GPCA Chair, 706-542-6144),
Jennifer Ceska (GPCA Coordinator, 706-542-6448) and
Anne Shenk (GPCA GEPSN Chair, 706-542-6128).

By Joshua A. Lee

A NEW POPULATION OF *Elliottia*

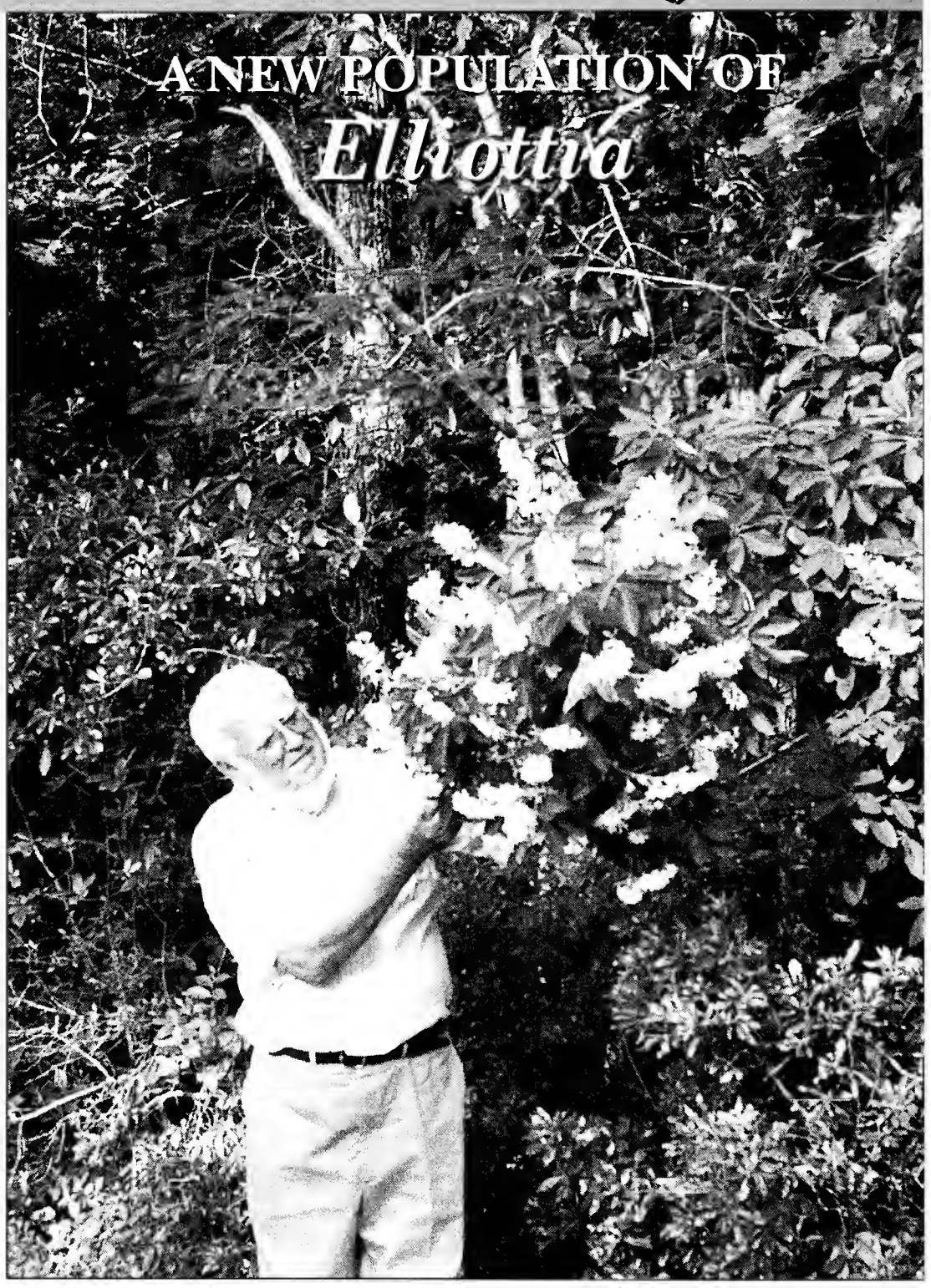


Photo by Dr. George Rogers

Joshua A. Lee examining Georgia plume

The evening of June 23, 1997, my wife Anna and I drove leisurely along the Rocky Ford Road, bound for our home in Sylvania. About a quarter of a mile east of the town of Rocky Ford, Anna mentioned that we'd just passed a bush with clusters of white flowers. I racked my memory for a white, late-June-flowering shrub that was native to Screven County but couldn't think of any. There was nothing for it but to go back and investigate.

There were two of the shrubs peeping from the forest edge. *Elliottia* came to mind, but I was reluctant to accept that, as the plant had not been reported from the eastern reaches of the Ogeechee River basin. But what else could it be?

We hurried home and called George Rogers, who lost no time driving over from his home in Statesboro. He confirmed that the plants were, indeed, *Elliottia racemosa.* In all, there were five plants, three of them small and somewhat suppressed by the competing forest. George took some snapshots, and we stood admiring the plants, exhilarated by the thought of finding yet a new site for this rare and endangered species.

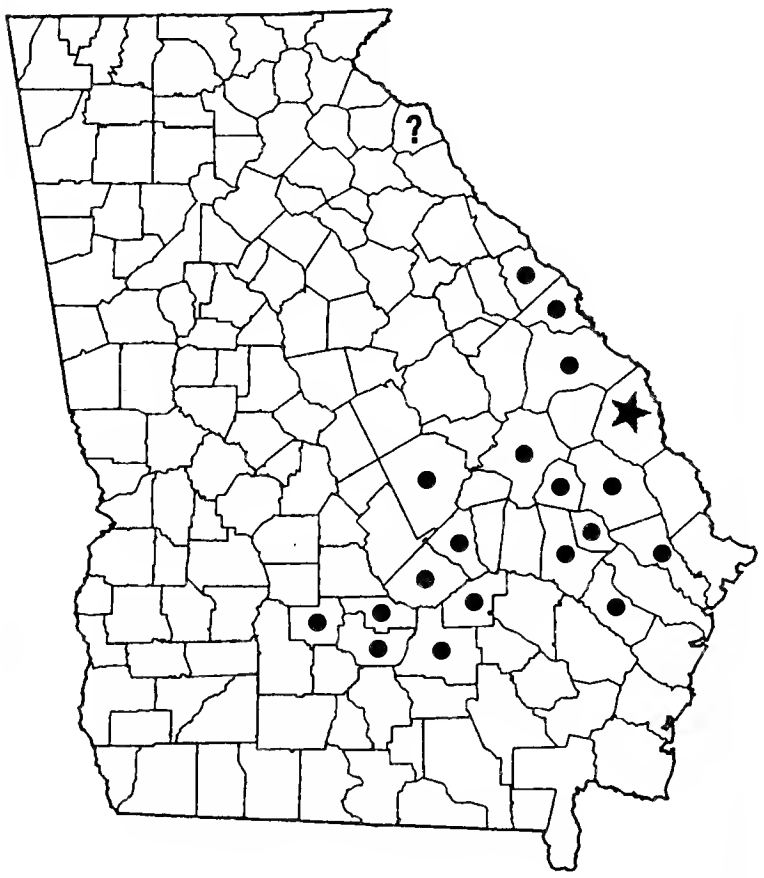
Later examination revealed that no seed pods had been produced. Quite likely the few plants at the site are clones from a common root stock, and *Elliottia,* like some other native shrubs and trees, might be self-incompatible.

The site is north of Mile Branch, just beyond the town limits of Rocky

Ford. The plants are growing on the verge of the Rocky Ford Road, and I've yet to determine whether the site is on public or private property. Either way I plan to return this winter and remove some of the competing vegetation.

Are there other populations of Georgia plume in Screven County? There could well be. I've written an article for the local weekly alerting people to be on the lookout for new stands of this rare and beautiful plant. I grew up less than two miles from the site and have passed the spot hundreds of times, but we didn't find it until June of 1997, and then only because of my keenly observant wife.

Editor's Note: Although the herbarium of the University of Georgia does not have a specimen of *Elliottia* from Screven County, its occurrence there is cited by C.E. Wood, Jr., in "The Genera of Ericaceae in the Southeastern United States," published in the Journal of the Arnold Arboretum in 1961.



Distribution of *Elliottia*, printed with permission of the Georgia Natural Heritage Program. Screven County is indicated by the star

HISTORICAL NOTE

The following information, under the heading Remarks, on page 64 of *Protected Plants of Georgia* by Patrick, Allison and Krakow (1995), is reprinted here with the permission of the Georgia Natural Heritage Program.

"The famed naturalist William Bartram (1739—1823) observed and collected this species in 1773, somewhere near the Savannah River in Georgia. Based on an interpretation of Bartram's "Travels," it has been suggested that he saw it in present-day Hart County, well removed from any populations known today. It was not collected again until about 1808, when Stephen Elliott found it near Waynesboro (Burke County). Henry Muhlenberg named the genus in Elliott's honor in 1810, for Bartram's earlier specimen lay unnoticed in the British Museum. Allegedly *Elliottia* occurred at two places in South Carolina, but these reports may have been based on transplanted material. Although it persisted in cultivation, no wild populations were known to science after about 1875 until 1901, when J. Walter Hendricks and Roland Harper rediscovered it in present-day Candler County. It has since been found at about three dozen other locations, all in Georgia. *Elliottia racemosa* is rare throughout its limited range, and has sustained significant habitat loss due to clearing of forest land for conversion to agricultural land or pine plantation."

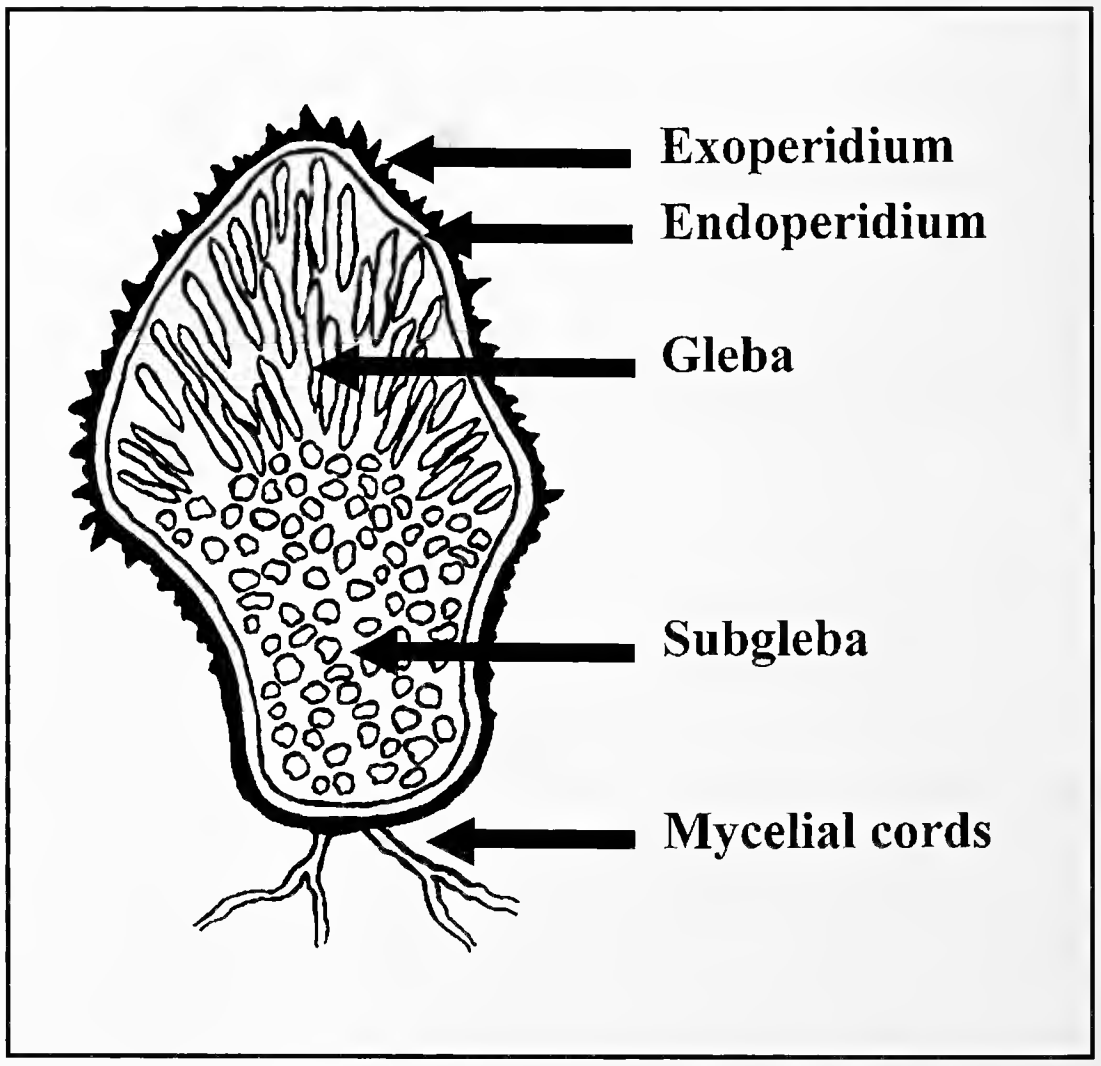
PUFFBALLS
of Georgia's Coastal Plain

By Bruce Horn

Professional mycologists and amateur mushroom hunters alike are drawn toward the standard mushroom that consists of a cap with underlying gills and a supporting stalk. Though the diverse colors and shapes of gilled mushrooms are truly an inspiring sight in the wet summer woods, I am inclined otherwise when on a mushroom foray. Walking along a trail and presented with a cluster of gilled mushrooms on one side and an equally impressive fruiting of puffballs on the other, I will proceed, without hesitation, to the puffballs.

Though seemingly simple in structure, their simplicity belies a fascinating biological complexity, and, for those who like the challenge of taxonomy, nothing can be more frustrating than identifying some of the less common species. This frustration arises because most major taxonomic treatments of puffballs in the United States were done over 50 years ago, in contrast to gilled mushrooms in which many genera have been examined taxonomically in recent times.

Nearly all groups of fungi have accumulated a peculiar set of descriptive terminologies, and puffballs are no exception (Fig. 1). A network of microscopic threads called the mycelium absorbs nutrients by decomposing wood, leaf litter and other plant debris. These mycelial threads, or hyphae, often aggregate into cord-like structures that produce the fruiting bodies. Fruiting bodies are encased by a peridium, which usually consists of an exoperidium and an endoperidium. The exoperidium



Drawing by Bruce Horn

Fig. 1 Cross-section of the immature fruiting body of a puffball. Shown are the outer covering comprising the spiny exoperidium and the endoperidium, the spore-producing gleba, the subgleba that forms the sterile base and the mycelial cords for transporting nutrients to the fruiting body.

is what gives puffballs their various ornamentations, including powdery granules, scales, warts, spines, hairs and fascicles (hairs joined at the tips). Within the peridium lies the fertile tissue of a puffball, the gleba. Spores are produced in the gleba and are intermixed with microscopic threads collectively called the capillitium. In some species, a portion of the gleba near the base remains sterile and is referred to as the subgleba. This sterile base can be stalklike and often persists long after the fertile gleba has disappeared and the spores have been dispersed.

Since the spores are enclosed within the fruiting body, puffballs have devised simple yet ingenious ways to disperse the spores. In *Calvatia* species, the top portion of the peridium sloughs away to expose the powdery gleba. The gleba, which remains spongy because of the capillitium, is highly hydrophobic, and raindrops hitting it produce a puff of spores; wind also directly disperses the spores. In the smaller fruiting bodies of *Lycoperdon* species, a porelike ostiole develops, and raindrops hitting the peridium result in clouds of spores blowing out of the ostiole like a bellows. Finally, many species of *Bovista* produce fruiting bodies that are attached to the ground by only a single mycelial cord, which, when broken, allows the mature fruiting body to blow across the landscape like a tumbleweed, discharging spores with every impact.

Most puffballs are edible when immature. Fruiting bodies should be sliced in half, and only those that are pure white inside should be eaten; if there is any trace of yellow, the taste will be bitter. Slicing puffballs in half will also prevent more serious consequences. The eggs of *Amanita* species, some of which are deadly poisonous, can be mistaken for puffballs except that a preformed cap and gills are visible when the egg is sliced. *Scleroderma* species, or earthballs, also resemble puffballs but are dark

Photograph by Bruce Horn

Fig. 2 ***Calvatia cyathiformis*** **fruiting on a lawn**

purple inside, and, as the genus name implies, usually have a thick hard skin. Earthballs have caused severe gastrointestinal poisonings.

Identification of puffballs is a particular challenge not suited to the impatient. With gilled mushrooms, fruiting bodies that are young and producing spores are ideal for identification. In contrast, it is often necessary to examine both immature and old, fully mature fruiting bodies of puffballs before an accurate identification can be made. Immature puffballs exhibit the characteristic ornamentations of the exoperidium but lack important microscopic characters. Mature fruiting bodies often change radically in appearance, particularly if they shed the exoperidium; however, these fruiting bodies contain spores and capillitial threads required for identification. Thankfully, immature fruiting bodies are found in the company of mature specimens from earlier fruitings.

Puffball Species

Although puffballs occur throughout Georgia, my experience with these fungi has been limited to the coastal plain in the southern portion of the state. However, the species discussed here are distributed throughout Georgia and much of the United States. For many people, puffballs are synonymous with species of *Calvatia*, which are often large and difficult to ignore. The most prevalent species during summer and fall in the coastal plain is *C. cyathiformis* (Fig. 2). It favors prairies, and, in Georgia, artificial prairies such as lawns and pastures provide a suitable habitat. The white-to-brown fruiting bodies eventually form a dark purple-brown powdery spore mass. The prominent sterile base may persist for several years after the spores have been dispersed.

C. cyathiformis often fruits in a circular pattern called a fairy ring, which arises from the radial growth of the mycelium from a central point. The inner portion of the mycelium eventually dies out, resulting in an expand-

Fig. 3 Immature fruiting bodies of *Lycoperdon marginatum* showing the spiny exoperidium

Photograph by Bruce Horn

ing mycelial ring where fruiting bodies form. Even in the absence of fruiting bodies, the fairy ring can be detected by its greener, more luxuriant growth of grass. In their classic work, Shantz and Piemeisel examined fairy rings of this species in the high plains of eastern Colorado. They determined that some of the rings were up to 420 years old, based on an expansion rate of approximately 24 cm per year. In Georgia, where growth conditions are far more favorable, growth of fairy rings should be much faster. Another species in Georgia, *C. craniiformis,* is similar in appearance but prefers open forests and has a yellow-brown spore mass when mature.

Smaller puffballs in the genus *Lycoperdon* are frequently encountered in Georgia's coastal plain. The most numerous, and perhaps the most difficult to recognize, is *L. marginatum.* It fruits in exposed areas such as lawns as well as in thin woods. Young fruiting bodies are white and covered with short sharp-tipped spines (Fig. 3). Upon maturity, the exoperidium of spines characteristically sloughs off in sheets to expose the smooth, dark brown endoperidium and the ostiole (Fig. 4). Only experience will allow you to recognize this puffball of many disguises.

L.pyriforme is one of the few puffballs that fruits on dead wood (Fig. 5). It occurs in large masses on logs, where fruiting bodies arise from an extensive network of rootlike mycelial cords. The exoperidium consists of fine granules and varies from white to rusty brown. A friend of mine, Martin Huss, determined that fruiting bodies in such masses are usually genetically identical and thus represent a single mycelial individual. Once, while taking refuge from a rain shower in the woods, I watched the large drips from a tree strike a group of mature *L. pyriforme.* With each hit on a fruiting body, a large puff of spores erupted from the ostiole like a small volcano.

Another common species, *L. perlatum,* fruits on the ground in forests, often in small clusters. Its exoper-

Fig. 4
Mature fruiting bodies of *Lycoperdon marginatum* in which the spiny exoperidium has sloughed off, exposing the smooth, dark brown endoperidium and the ostiole

Photograph by Bruce Horn

idium consists of cone-shaped spines of two sizes that are arranged in an orderly manner. The large spines leave a distinctive scar on the fruiting body when shed.

The most numerous representative of the genus *Bovista* on the coastal plain is *B. pusilla.* It fruits on lawns and disturbed ground and is easily overlooked because of its small size (less than 2 cm in diameter). After a soaking summer rain, the white, nearly smooth fruiting bodies of *B. pusilla* are the first mushrooms to appear, usually within a day or two. Fruiting bodies become coffee brown and develop a large ostiole upon maturity.

Many other puffball species occur in Georgia, particularly representatives of *Lycoperdon.* Because of their neglect by professional mycologists, puffballs offer many opportunities for amateur mycologists to make important contribributions to the field. Rather than greeting the next puffball with a hefty kick, stoop down for a closer look and perhaps even collect it for additional study.

Photograph by Bruce Horn

Fig. 5
Lycoperdon pyriforme **fruiting on a rotten log**

References

Coker, William C. and John N. Couch, 1928, The Gasteromycetes of the eastern United States and Canada, University of North Carolina Press.

Huss, Martin J., 1993, Spatial distribution among mycelial individuals of *Lycoperdon pyriforme* occurring on decaying logs, Mycological Research 97:1119-1125.

Miller, Orson K., Jr., and Hope H. Miller, 1988, Gasteromycetes: morphological and developmental features with keys to the orders, families, and genera, Mad River Press.

Shantz, H. L. and R. L Piemeisel, 1917, Fungus fairy rings in eastern Colorado and their effect on vegetation, Journal of Agricultural Research 11:191-245.

Smith, Alexander H., 1951, Puffballs and their allies in Michigan, University of Michigan Press.

Fothergilla gardenii:

Rare Jewel of the Coastal Plain

By Martha S. Joiner

My love affair with the native plants of the coastal plain really began when my husband and I decided to build a new house in 1991. We bought our wooded lot on a pond and started looking for a house plan. The place seemed so special to us that we decided not to clear our lot when we built the house and to design a natural garden using the native plants that were there and adding other attractive natives as we could find them. When I began trying to find out what all these plants were that shared the place with me, I realized that after 20 years of gardening in south Georgia I had learned almost nothing about the local flora. I also discovered that I knew so little about botany that I could not even use the keys I had obtained to help me identify species. My interest in learning more about botany and local native plants led me to enroll in a master's degree program at Georgia Southern University.

My thesis project was a propagation study using plants in the witch-hazel family, Hamamelidaceae. I was particularly interested in witch-hazel (*Hamamelis virginiana*) because of its medicinal and herbal properties, but I was delighted to learn of another genus in this family, *Fothergilla.* Most of our lot is very wet, and I had been looking for plants for boggy conditions. I had obtained a specimen of *Fothergilla* from a native plant nursery in Florida prior to my interest in the Hamamelidaceae. The descriptions of this plant in all of my gardening books told me that this was one I really wanted in my garden. After completing my thesis and learning about many other native plants of the coastal plain, this little gem is still a favorite.

What's In a Name?

The story of the naming of *Fothergilla gardenii* begins in the late colonial period in the United States. It was named for two distinguished naturalists, Dr. Alexander Garden of Charleston, South Carolina, and Dr. John Fothergill of Essex, England. John Bartram, an early explorer and collector of the flora of the southeastern United States, paid a visit to Dr. Garden in mid-March 1760. While there, he collected many plants and kept detailed notebooks describing them and their native habitats. Sometime between 1760 and 1765, Bartram sent live plants of this species to friends in England. In his notes he called this plant *Gardenia* in honor of Dr. Garden. In 1765, Dr. Garden sent the plant to Carl Linnaeus to be catalogued in the work that Linnaeus was compiling to document and name all the world's plants. Garden called the plant *Anamelis.* Linnaeus had already received specimens of a related plant *Hamamelis,* and at first he thought that this was the same plant. In 1769,

William Young, Jr., unaware of the previous discovery of the plant, sent a specimen to Dr. Fothergill calling it *Youngsonia.* Fothergill forwarded this specimen to Linnaeus also. Finally, Linnaeus concluded that this really was a unique species, but since he already had a plant called *Gardenia,* he named this one *Fothergilla gardenii* to honor both Fothergill and Garden.

Linnaeus' description and the name of *Fothergilla* appeared in the 1774 edition of *Species Plantarum.* However, this edition was edited by an associate of Linnaeus', Johan Andreas Murray, and was published after Linnaeus' death. Taxonomists, therefore, list the author of the species as Murray since he was the first to publish the description. The infrequently used common name, dwarf witch-alder, probably comes from the plant's similarity to both witch-hazel, *Hamamelis,* and mountain alder, *Alnus.* Most people know the plant by its generic name of *Fothergilla.*

Currently, most authorities feel that there are only two species of *Fothergilla, F. gardenii* and *F. major.* Since they were discovered, however, there has been a controversy concerning the taxonomy of these two species. Both species are quite variable, and early taxonomists interpreted these differences to be distinctions among different species rather than within a species. Consequently, there are many *Fothergilla* species in the literature. In 1969, Richard Weaver undertook a major study to clarify this nomenclatural dispute, and his conclusion was that there was no basis for separating this genus into more than two species. These two species are still causing confusion in the nursery trade, and a recent study by Ross Clark indicates that most of the plants sold as *F. gardenii* are actually *F. major.* He found that the most important distinguishing characteristics were 1) whether the plant flowers with or without the leaves (*F. gardenii* before the leaves, *F. major* along with), and 2) the habitat and geographic range of the native populations. *Fothergilla gardenii* grows in bogs and pocosins in the coastal plain, while *F. major* is a montane species. For cultivated plants, Clark recommends separating them by chromosome numbers (*F. gardenii,* $n = 24$; *F. major,* $n = 36$). One of my future projects is to apply some of the newer molecular techniques to the problem of speciation in *Fothergilla.*

Description and Distribution

A thorough description of *Fothergilla gardenii* was given by R. K. Godfrey. He described the plant as a slender, deciduous shrub usually growing to a height of 1 m but often smaller. A population of *Fothergilla gardenii* at Ft. Stewart in southeast Georgia, however, has some plants in a shaded area which are growing to heights of at least 3 m. (The 1996 issue of Tipularia contains an article on the rare flora of Ft. Stewart that refers to this population of *Fothergilla.).* Typical of the family Hamamelidaceae, both sides of the leaves, buds and twigs are covered with dense hairs, occurring in clusters resembling stars. As the plants age, the hairs become sparse, and on some older specimens only

the undersides of the leaves exhibit this stellate pubescence. The leaves are mostly obovate, occasionally broadly elliptic, about 2–6 cm long and 1.5–3 cm wide. The bases of the leaves are round, truncate or broadly cuneate, while the apices of the leaves are obtuse and rounded with either smooth margins or crenated margins on the uppermost one-third of the leaf. The vegetative buds are naked, and the terminal bud looks like a scalpel blade with a short stalk. Lateral buds occur singly, are short and are not stalked.

The flowers are borne on the bare branches, forming a dense, oblong spike sometimes described as resembling a bottlebrush. They appear from March to May depending on the location and the weather conditions. In southeast Georgia, flowering time is usually early to mid-March. The inflorescences are white or cream-colored, 3.5–4 cm long and 2.5 cm in diameter. Flowers are bisexual, or the lower ones along the spine may be unisexual male. There are no petals; the flower color is due to the stamens which have long white filaments with yellow anthers. The flowers exude a fragrance resembling honeysuckle. The fruit is a capsule fused to the floral tube, and there are two shiny, oval seeds, one in each locule. The capsules are very similar to those of witch-hazel except the seeds and capsules are smaller. Seeds vary in length from 4.8 to 6.3 mm. Sources indicate that the seeds mature in August.

Fothergilla gardenii is distributed across the coastal plain from North Carolina to north Florida and west into southern Alabama. It frequently grows in pocosins with sparse pine populations and on the edges of pitcher plant bogs. Other taxa associated with it are *Myrica, Clethra, Persea, Magnolia, Pinckneya, Vaccinium* and *Gaylussacia.* Fire has probably

Photo by Martha S. Joiner

Population of *F. gardenii* in bloom at the Baileys' property in Emanuel County, Georgia, on April 4, 1998

been critical to its maintenance, because it requires full sunlight or very light shade and only spreads when competing plants are cleared out. It is presently considered rare, threatened or endangered in all of its range. The population at Ft. Stewart is adjacent to a fire break, and the area is also burned periodically. One of the sites in Emanuel County is just outside a fenced cow pasture that is frequently mowed. Some of the plants are actually inside the pasture and are grazed by the cows. The third site in Emanuel County is on property now owned by Diann and Alan Bailey of Savannah. The land was timbered before they acquired it, but they plan to manage the land for the conservation of this plant and others on the property.

Research

Three large native populations of *F. gardenii* were studied in southeast Georgia in connection with my thesis research (one at Ft. Stewart and two others on separate private tracts in Emanuel County). All three produced seed capsules that were evident when the sites were visited in May 1997, but return trips from the beginning to the middle of July revealed that many capsules had shriveled and fallen from the plant or had already dehisced by this time. It appears that during some years seeds are formed much earlier, if they form at all, in this area of the plant's range. In the future, attempts will be made to collect seeds in early June.

Little is known about *Fothergilla* pollination except that it is thought to be bee-pollinated because of the flower structure. The plant spreads by underground rhizomes or roots, and large colonies can be produced asexually from a single plant. If the plant requires cross-pollination for a high percentage of fruit to set seed, these asexually produced populations would not produce many viable seeds. This would explain the reports by investigators that the plants do not produce seeds. Molecular studies will be helpful to determine whether naturally occurring populations consist mostly of clones from one plant or if they are the result of individual seeds germinating.

Cultivation of this plant as a landscape specimen is not difficult if its basic requirements can be met. These include sandy, acid soil containing organic matter. The plant will thrive in moist, partial shade conditions, but for the best flowering and fall color production, it should be grown in full sun with plenty of moisture.

One of the objectives of my thesis research was to describe propagation techniques that could be used by amateur gardeners to propagate small numbers of plants of our native species for their own gardens. This would help to preserve the species and would encourage gardeners to use the native species for landscaping. It would also help to increase the genetic diversity of landscape plants, since most nurseries propagate from stock plants using asexual methods.

My efforts to propagate *Fothergilla* were limited to stem cuttings and seeds. I followed the guidelines in standard references on propagation, but I believe much of this information was obtained using cultivated

plants. I used cultivated plants also until I was able to find native populations. My cuttings were taken initially from three specimens of *Fothergilla gardenii* cv. 'Blue Mist' that are located at the Georgia Southern University Botanical Garden. The cuttings were collected at 2-week intervals beginning in June and continuing through July. I tried applying a rooting hormone to some of the cuttings and rooting some without. The hormone preparation did not appear to increase rooting, and it also contained a fungicide. I have since done some research on mycorrhizal associations between plant roots and beneficial fungi and believe there may be some advantages in not using fungicides in propagation, because they destroy beneficial fungi as well as pathogenic types. My goal now is to use only organic methods in my propagation of native species. I used a plastic bag to form a simple humidity chamber for the cuttings and kept them on a screened porch out of direct sun but in bright light.

After finding the three local populations, I took cuttings from these areas. The best time to collect cuttings in the wild appears to be May. Cuttings taken later root fairly readily, but, because plants in this family do not produce root hairs, they take a long time to produce a viable root system. In order to survive the first winter, cuttings need to establish roots and begin new growth before cold weather forces them into dormancy. The long growing season in our coastal plain is beneficial to both the plant and the propagator. I also repotted my cuttings after rooting into a mixture of ground pine bark and topsoil and treated them with a slurry containing soil from the roots of the parent plants to be sure they had a source of mycorrhizal fungi. Plants that don't produce root hairs seem to benefit more from mycorrhizae than those that do. Protecting the rooted cuttings from freezing temperatures during the first winter is also advisable. Using these methods, I have obtained a limited number of rooted cuttings. As a gardener, I think I'd prefer to do my propagation using seeds. It is more natural and a lot easier.

As mentioned earlier, seeds from native populations of *Fothergilla gardenii* have not yet been collected. I hope to do this in 1998. Good germination (70% the first spring) was obtained with fresh seeds of *Fothergilla*'s

Photo by Martha S. Joiner

Dr. George Rogers surrounded by *F. gardenii* at Ft. Stewart, May 16, 1997

more common relative, witch-hazel, using a combination of warm and cold stratification. The same technique was used with some *Fothergilla gardenii* seeds obtained from the North Carolina Botanical Garden. These were not fresh seeds but were from 1995 and were received in May of 1997. I put them into a plastic bag containing 1:1 by volume sand and peat moss dampened to the consistency of a wrung-out wet sponge. The bag was kept on a screened porch at ambient temperature until the first of November. Then it was placed into the refrigerator at about 4°C until the first of February, when the seeds were sown in a seed flat and kept in the kitchen at about 25°C. As of March 15, 1998, 3 seeds out of 23 have germinated. I plan to try this stratification technique with fresh seeds from 1998.

My relationship with *Fothergilla gardenii* has been so positive that it has led me to investigate other beautiful and endangered plants of the coastal plain. I am now working with the Georgia Plant Conservation Alliance to conserve through seed propagation some of the pitcher plants and the Georgia plume, *Elliottia racemosa.* Gardening, for me, has moved into a new realm of working to preserve our native plants and promote their use in landscaping.

I would like to acknowledge the invaluable help given to me by my thesis committee at Georgia Southern: Dr. John Averett (my advisor), Dr. Don Drapalik and Dr. Ray Chandler (committee members) and especially Dr. George Rogers. Dr. Rogers was on my committee and has also been a great friend and fellow botanizer, helping me find the first native population of *Fothergilla* in Emanuel County and continuing to explore the woods with me, sharing his vast knowledge of the local flora. Funding for this research was provided by the Georgia Southern University Graduate Student Professional Development Fund.

Further Reading:

Berkeley, E. and D.S. Berkeley, 1969, Doctor Alexander Garden of Charles Town, University of North Carolina Press.

Bir, R.E., 1992, Growing and propagating showy native woody plants, University of North Carolina Press, 192 pp.

Clark, R.C., 1987, Another southern delight: the witch alders (*Fothergilla* spp.), Morton Arboretum Quart. 23:33-39.

Corner, B.C. and D.D. Booth, 1971, Chain of friendship: selected letters of Dr. John Fothergill of London, 1735-1780, Harvard University Press, 538 pp.

Dirr, M.A. and C.W. Heuser, Jr., 1987, The reference manual of woody plant propagation: from seed to tissue culture, Varsity Press.

Fordham, A.J., 1971, Propagation of Fothergilla, Arnoldia 31:256-259.

Godfrey, R.K., 1988, Trees, shrubs, and woody vines of northern Florida and adjacent Georgia and Alabama, University of Georgia Press.

Kral, R., 1983, A report on some rare, threatened, or endangered forest-related vascular plants of the south, vol. I, Technical Publ. R8-TP2, USDA Forest Service, 586-587.

Weaver, R.E., 1969, Studies in the North American genus *Fothergilla*, J.Arnold Arboretum, 50:586-587.

Broxton Rocks Ecological Preserve:
Bryophyte Refugium of South Georgia

By Dana Griffin III & Frankie Snow

Regular readers of Tipularia need no introduction to Broxton Rocks, south Georgia's fascinating sandstone outcrop. Vicky Holifield's article (Tipularia, Spring 1989) serves admirably to highlight several of the vascular plant specialties, some endemics, others disjuncts, that call Broxton Rocks home. But what about nonvasculars, groups like bryophytes and lichens? Holifield mentioned one lichen (*Cladonia*) and two mosses (*Grimmia* and *Polytrichum commune*) that frequent the Miocene-Age flat rocks, but in the late '80s little else was known about local diversity among these groups.

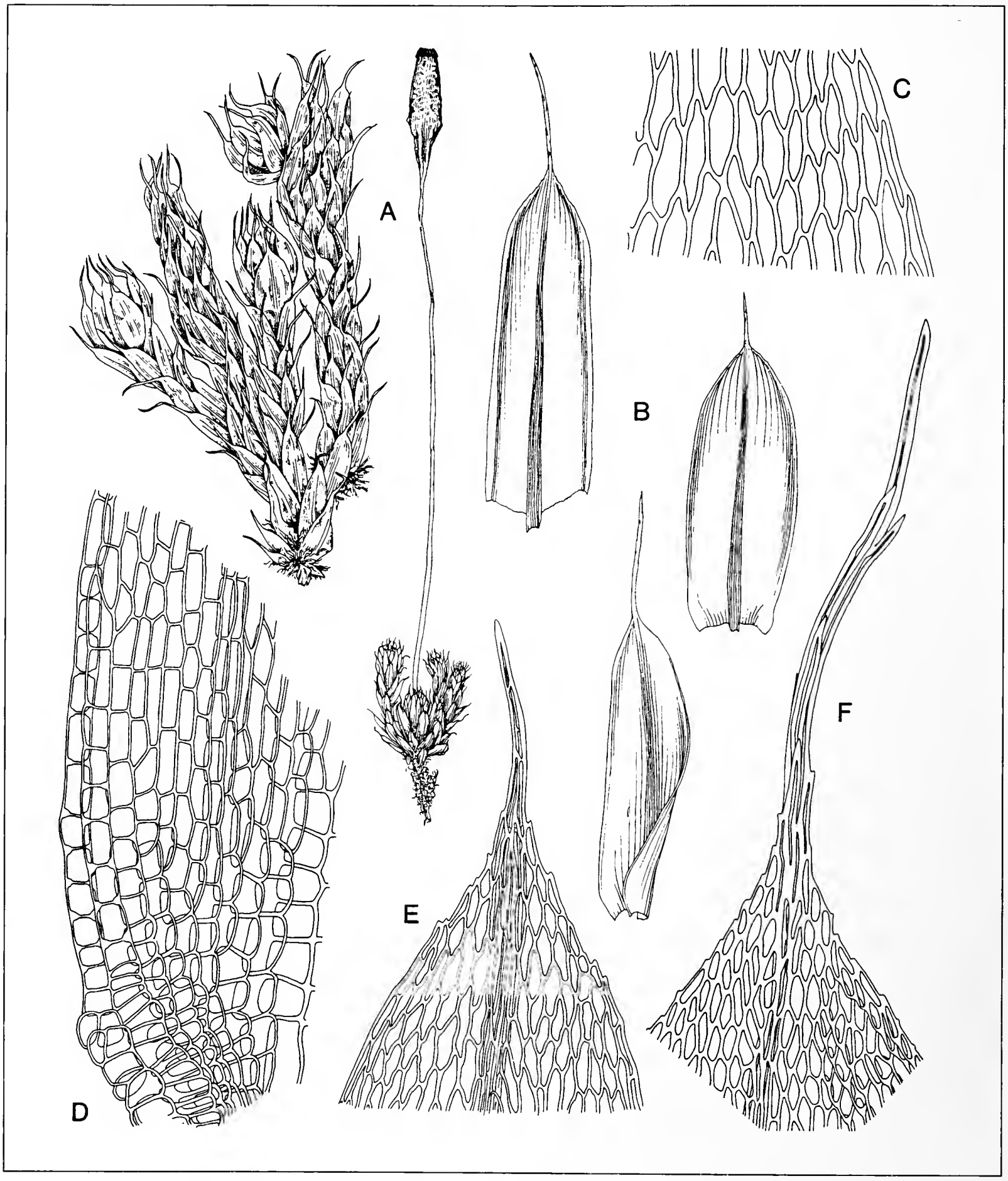
In the early 1990s, the authors began a survey of the mosses, liverworts and hornworts of south Georgia's sandstone exposures. In time they were joined by Drs. Bill Buck and Richard Harris, both of the New York Botanical Garden. Dr. Harris is a lichenologist, and his addition to the survey team broadened the scope of the work to include lichens. The lichens of Broxton Rocks and environs are sufficiently diverse as to justify their own publication, so they will not be dealt with here; however, an initial report on the bryophyte inventory has been published (Griffin, Snow and Buck, 1994). We want to acknowledge the contribution of collections and of help with identification by Dr. Lewis E. Anderson of Duke University and Dr. Paul Davison of the University of North Alabama.

To date, 75 moss species have been collected at Broxton Rocks, along with 36 species of liverworts and one species of hornwort. Exploration on other Altamaha Grit outcrops in southern Georgia has added 11 more species of mosses. For perspective, Lampton (1970) listed 315 species of mosses for the entire state of Georgia. This means the 620 acres initially purchased by The Nature Conservancy, and now called Broxton Rocks Ecological Preserve, host around 24% of Georgia's moss diversity.

Of all the sandstone outcrops found south of the fall line, those at Broxton Rocks are the largest in acreage and show the most extensive weathering. The result is an increase in the number of microenvironments, which translates directly into increased biodiversity.

While these sandstone outcrops are considered to be middle Miocene in age, they were likely not available for colonization by flora until much later, probably during the early Pleistocene. It is thought that Miocene-Age fluvial sand and clay deposits eventually became indurated (hardened by pressure and cementing material) to form sandstone that was embedded in a matrix of unindurated material (Huddlestun, 1988). The sandstone would not be available to plant life until much later when it was exposed by erosion. The encroachment of Pleistocene seas also affected when this sandstone would be avail-

able for plant colonization. The Hazlehurst Terrace, which lies only a few miles east of Broxton Rocks, is a remnant of the sea bed during early Pleistocene times (about 2 million years ago). Today this marine terrace is marked by an escarpment elevated 230-270 feet above current sea level. Since sandstone generally lies at 225 feet above sea level, had it been freed from its encapsulating Miocene soil, it would likely have been drowned by this Pleistocene sea, which would have erased plant life existing at the time. These sandstone outcrops would have been unavailable to plants until



Brachymenium systylium. A) habit (x11, x4). B) leaf outlines (x33). C) cells above leaf middle (x293). D) cels at leaf base (x270). E) cells at leaf tip (x270). F) cells at leaf tip, showing variation in length of hairpoint (x213). (*This reprinting in Tipularia represents 75% of dimensions in the original publication. This affects all of the magnifications shown.*)

the sea retreated further eastward to the area of the Pearson Terrace.

Several distinct communities of bryophytes grow on the rock surfaces. While we have not taken any physical measurements in connection with this field work, the three interrelated factors that seem to be most at play in influencing the occurrence of these communities are moisture, light and temperature. This is hardly surprising, but what draws our interest is the challenge of trying to follow how the subtle interplay of these parameters defines a community's boundary. Such interplay is far from easy to discern. At Broxton Rocks, adjacent outcrops which appear similar may not support the same set of bryophyte species, so there may be other elements at work, including randomness and chance.

To complete this brief overview of environmental factors, seasonality must be mentioned. While virtually all lichens are perennials, this is not true of bryophytes, at least not to the same degree. At Broxton Rocks there is a late winter-early spring flora of ephemerals which are on a fast track of development, their spores germinating with the first drop in temperature in the fall or early winter. By late winter or early spring the next generation of spores is matured and ready for dispersal. During the warmer months they are not to be found at all, existing only in the form of spores dispersed in thin soil and crevices of the sandstone. These are rather specialized bryophytes represented by such genera as *Archidium*, *Bruchia*, *Eccremidium* and *Pleuridium* among the mosses, and *Fossombronia* and *Riccia* among the liverworts. The niche they occupy might be compared with that of desert annuals: They flourish during the coolest seas-

Photo by Frankie Snow

Waterfall habitat on Rocky Creek

on and when moisture is readily available. These cool season ephemerals are sometimes called pygmies by bryologists, due to their reduced stature. Many do not exceed 5mm in total height, so they can be easily overlooked by the casual visitor to the Preserve.

On the flat top of the outcrops, on essentially dry surfaces, one finds *Grimmia laevigata, Campylopus pilifer, Hedwigia ciliata, Dicranum condensatum* and *Polytrichum commune.* With the exception of the *Dicranum,* which is endemic to eastern North America, all the other species are distributed widely in the Northern Hemisphere or are cosmopolitan. On other outcrops, water gathers in shallow depressions, and this allows for the establishment of rock pool communities. Here an unusual and colorful peat moss, *Sphagnum cyclophyllum,* is encountered. This is one of the very few species of *Sphagnum* to develop simple, not fasciculated, branches, and its amber-to-burgundy color gives the margins of these rock pools a special character. Several other bryophytes typify this "aquatic" habitat, including *Archidium hallii, Aulacomnium palustre, Campylopus tallulensis, Eccremidium floridanum, Fossombronia braziliensis* and *Riccia sorocarpa.* Also occasionally found here is the rare moss *Campylopus carolinae,* a candidate for federal listing.

The extensive weathering of the Broxton Rocks sandstone has left the outcrops with many fissures. Some are too narrow to explore any deeper than an arm and hand can reach, while others are of sufficient width as to create "canyons" easily accessed by an adult naturalist. The vertical faces of the fissures can vary from dry and sunny to shady and moist, depending on their orientation and

Photo by Frankie Snow

Drs. Jon Shaw, L.E. Anderson, Richard Harris and William Buck inventorying bryophytes and lichens at Broxton Rocks

water supply. A few of the canyon walls and bluffs are seasonally or constantly wet from seeps. Not unexpectedly, the bryophytes of these habitats will differ as a direct reflection of the particular mix of moisture and light factors. Species typical of dry vertical faces include *Cheilolejeunea rigidula, Frullania ericoides* and *Leucolejeunea clypeata* among the liverworts, and *Anomodon attenuatus, Ptychomitrium incurvum* and *Schlotheimia rugifolia* among the mosses. By contrast, on seepy bluffs one finds robust populations of *Bryoandersonia illecebra, Sphagnum subsecundum, Scapania undulata, Porella pinnata* and *Odontoschisma prostratum.*

It was on a relatively dry bluff that we discovered a few plants of the moss, *Brachymenium systylium,* a record for the Georgia flora of this tropical species. This is far from being the only tropical allied taxon at Broxton Rocks. We note with interest the mention by Holifield (1989) of the orchid, *Epidendrum conopseum,* and the herbaceous dicot, *Portulaca biloba,* both of which have direct links to the floras lying far to the south of Georgia.

Rocky Creek, a tributary of the Ocmulgee, drains a considerable part of the core acreage now preserved by The Nature Conservancy. In its flow is found a ten foot high waterfall, surely one of the more enchanting landforms for the southern part of the state! On a ledge under this waterfall we came across the liverwort, *Gymnocolea inflata,* a boreal-cool temperate disjunct. This was the first record of this species from the coastal plain of Georgia and added another dimension to our growing conviction that Broxton Rocks represents a plant refugium.

Refugia, as we are accustomed to think of them, combine long-term

Photo by Frankie Snow

Cave entrance showing bryophyte habitat

stability with niches that allow epibiotics to survive. Epibiotics are species literally left behind by advancing or retreating floras. They are often relic in behavior. While not to be compared with the southern Appalachians for physical size, age or biotic diversity, Broxton Rocks nevertheless can be regarded as an authentic plant refugium.

Its most unusual, and perhaps valuable, feature may be its location. Coastal plains, whether of Georgia or any other state, are typically the most recently emergent land found on a continent. Their floras tend to be characterized by adventives or early successional taxa, well known for their polymorphism and taxonomic difficulty. Coastal plains, on first reflection, would appear to be the least likely of all life zones to harbor a refugium. So the fact that there occurs on Georgia's coastal plain a weathered set of Miocene sandstone supporting in relative proximity the pantropical moss, *Brachymenium systylium,* and the boreal liverwort, *Gymnocolea inflata,* is worth noting. That such a habitat deserves preservation is beyond question.

Literature Cited

Griffin, Dana III, Frankie Snow and William R. Buck, 1994, The bryophytes of Georgia's sandstone outcrops: I. The Broxton Rocks Ecological Preserve, Evansia 11(3):81-87.

Holifield, Vicky, 1989, True grit: Georgia's other outcrops, Tipularia 4(1):2-8.

Huddlestun, Paul F, 1988, A revision of the lithostratigraphic units of the coastal plain of Georgia, the Miocene through Holocene, Georgia Geological Survey Bulletin 104:100-107.

Lampton, Robert K, 1970, Mosses of Georgia. A check list of species which have been collected within the state, Bulletin of the Georgia Academy of Science 28(3):81-98.

Photo by Frankie Snow

Outcrop on western branch of Rocky Creek

Dr. Emma Lewis Lipps

1919 – 1996

By Wilson Hall and Richard Ware

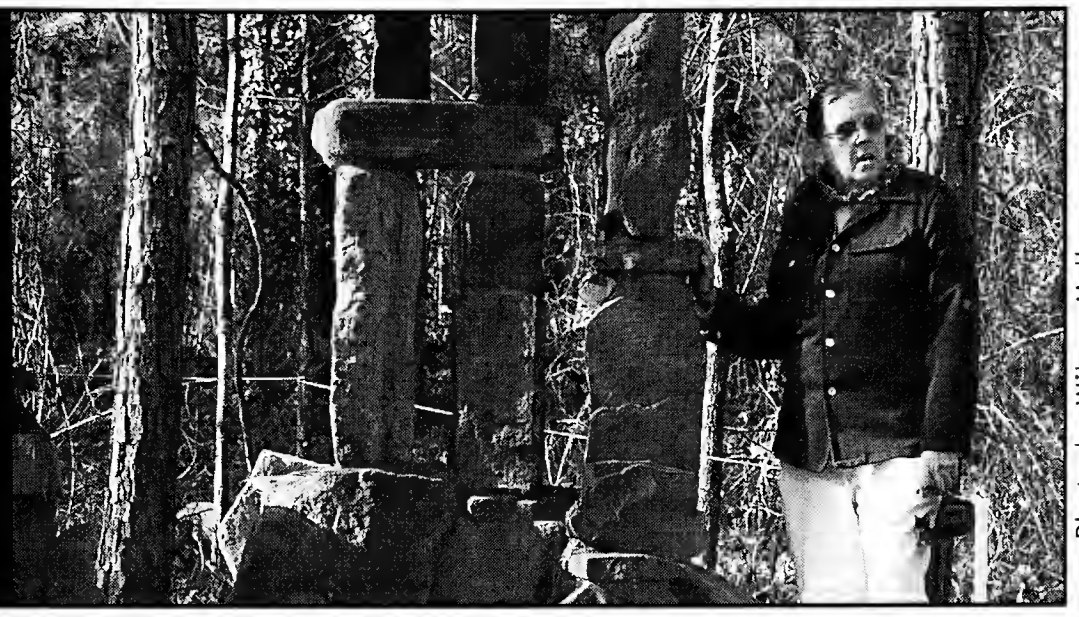


Photo by Wilson Hall

Dr. Emma Lewis Lipps was renowned for almost half a century as a teacher of earth science at Shorter College in Rome, Georgia. But she was far larger than her classroom and her title of "Professor." As a spokesman for the college said, "Her career has been dedicated to promoting the well-being of planet Earth and those who live upon it." She touched the lives of thousands of students who went on to become botanists, ecologists, physicians, teachers, ministers, lawyers and businesspeople. However, her legacy was not only people who would become leaders in our society but also important places, like Marshall Forest, Black's Bluff and Ladds Quarry, places that will enrich not only our own lives, but those, we hope, of many generations to come.

Dr. Lipps was the consummate teacher. She taught small children to love the earth. She taught the old, the infirm and the blind to love trees and all growing things. She was adamant that there be a "Braille Trail" in the Marshall Forest and that it be capable of conducting wheelchairs and their riders to the magnificence of trees. And she taught the importance of preserving natural sites.

Marshall Forest Because of her long-standing friendship with MacLean Marshall, whose family had received the land in the 1832 Georgia Land Lottery, she was able to spend her half-century of teaching in the Marshall Forest. Here she discovered that the forest was virgin, and in 1966 she had the federal government declare it a Registered National Landmark. Later, at the end of MacLean Marshall's life, she asked him to deed the forest to The Nature Conservancy for safe-keeping forever.

Dr. Lipps did the research for her doctoral dissertation in the Marshall Forest, discovering there the federally endangered large-flowered skullcap (*Scutellaria montana*). She established forty 0.1-acre plots in 1960 in a heavily wooded portion of the forest. In all plots all vascular plants were identified and noted by presence (herbs), size class (trees) or cover percentage (shrubs and woody vines). Voucher specimens of collections were placed in the Shorter College Herbarium in Rome and in the herbaria of the University of Tennessee (Knoxville), Southern Methodist University (Dallas, Texas) and the University of Georgia (Athens).

Her dissertation, entitled "Plant Communities of a Portion of Floyd County, Georgia – Especially The Marshall Forest," was completed in December of 1966. This is a 207-page work which starts with the 1832 Georgia Land Survey Records and ends with the year 1966. All known information about the natural history of the county was included, including geology, climate, soils, human history, botanical exploration and flora. In 1969 Dr. Lipps co-authored with H. R. DeSelm "The Vascular Flora of the Marshall Forest, Rome, Georgia" (Castanea 34:414-432), which contained some 300 species of plants.

Beginning with Dr. Lipps' early days in the forest, she took students to the area to study dendrology (the science of trees), soils and general botany. Under her direction, Shorter students planned and built the system of three nature trails through the forest, one of which is the Braille Trail established for the use of the blind and handicapped, tagging plants with the common, scientific and family names of the different species. Shorter is one of several colleges and universities which have used the forest as a "living laboratory" for the study of numerous things related to nature.

Black's Bluff In 1973 Dr. Lipps and John Butler, then president of the Rome chapter of the Georgia Conservancy, went before the Floyd County Board of Commissioners and successfully asked that the area called Black's Bluff, originally known as Cliffs of the Coosa, be saved and protected from further quarrying by the county's rock mining operation. Dr. Lipps cited the many rare and endangered plants located there and also a cave where Dr. Phillip Greear and Wayne Walker discovered the bones of a pleistocene bear.

At Black's Bluff she found more large-flowered skullcap and the rare limerock arrowwood (*Viburnum bracteatum*). Black's Bluff remained open to the public after it went to The Nature Conservancy, but Marshall Forest was held as a closed research area for scholars. Both, however, continued from 1944 until her retirement to be her classroom.

Ladds Quarry At Ladds Quarry, in Bartow County, Dr. Lipps and her students found bones of the mammoth, pleistocene bear, sloth, tapir, giant turtles, jaguars, an extinct type of mouse, chipmunks, birds, fish and amphibians, as well as the shells of snails. Altogether, she recovered some 100 kinds of animals, more than all the fossils known to Georgia since 1823. They were shipped to the Smithsonian Institution, where, in the summers, Dr. Lipps would do the sorting and storing, earning the respect and friendship of some of America's foremost scientists.

In summing up her philosophy about the preservation of these areas for future generations, Dr. Lipps was fond of saying, "They will provide answers to questions we are not yet able to ask." She will be remembered as an eminent ecologist whose ideas were years ahead of her time and as a teacher who had a great and positive influence over her students. In all the people whom she influenced she was a perceptible force in preserving this planet that we all share.

Rashomon on Davidson Creek

By John Garst, Gary Newton and James Sullivan

GN's Memoir

In about 1992, John Garst introduced me to the fascinating world of wildflowers. In order to explore numerous botanically interesting areas, John, his wife, Edna, and I (and usually other friends) have made many memorable trips to Panther Creek between US 441 in Habersham County and Yonah Dam in Stephens County. Each year, as spring approaches, John concocts trips into largely unexplored areas that are not always easily accessible, and I have been fortunate to have been included on many of these jaunts. Davidson Creek, a tributary of Panther Creek, has commanded our attention over the past few years.

John has a map which shows the various geological strata along part of Davidson Creek, indicating areas that look especially interesting for exploration. Topological maps suggest the degree of difficulty that can be expected in accessing these areas. However, no map indicates how thick the undergrowth may be – that must be learned by experience. We have had some interesting experiences indeed.

Over much of the range of Davidson Creek, access to the creek is relatively easy. For example, a Forest Service road over a water pipeline allows easy walking there. However, access to some of the interesting sites can be challenging. The bluffs on the road side of the creek are mostly

Photo from Hugh and Carol Nourse

John Garst contemplating Sweet Ravine at Davidson Creek

gentle slopes, but on the other side they often rise very sharply. At one end of the range we have covered, Davidson Creek is a gentle, meandering stream with a sandy bottom and a wide flood plain. Other sections of Davidson Creek are rocky, steep and turbulent. Still another section is rapidly flowing with a rocky bottom and a narrow flood plain. A section with very steep rises on both sides of the creek has a half-mile series of cascades, which can be clearly heard but not seen from the road. It requires good effort to get into that area.

One access route to Davidson Creek is a rather steep descent along an unnamed tributary. At one point in the descent, a rather impressive waterfall can be seen and admired. If you are not expecting it, as on our first trip on this route, it causes "oohs" and "ahhs" when it comes into view. Other lesser waterfalls on other tributaries can be found along this access road.

On one of our treks, John and I discovered a unique canyon. As you walk up a mountain along a tributary, the sides of its ravine grow steeply, and nearly vertically, to at least 14-16 feet high. Thus, you find yourself in a very narrow canyon that seems to go on for a long distance, gets deeper and steeper as you continue and presents a few small waterfalls to contend with. This canyon contains a large number of some of the biggest and most beautiful Vasey's trillium (*Trillium vaseyi*) that I have seen. I still remember that we ate lunch sitting among a great collection of these excellent flowers. A most memorable experience!

From vague clues, John had the notion that an undiscovered, exceptionally rich botanical area probably exists along Davidson Creek. In late March 1997, John, Jim Sullivan and I found a small, quiet, level area nested between Davidson Creek and a very steep ravine. We call it the "sweet spot." There are small pools of very clear water, likely over marble bottoms, that contain thousands of tadpoles. The area is strewn with large boulders. Davidson Creek is directly adjacent and presents a terrific scene of water cascading over the large rocks. Plants found in profusion in the sweet spot include walking fern (*Asplenium rhizophyllum*), spring beauty (*Claytonia virginica*), green violet (*Hybanthus concolor*), southern nodding trillium (*T. rugelii*) and bishop's cap (*Mitella diphylla*).

The sweet spot is truly a soothing and refreshing place to spend a few hours. Getting there, however, is not exactly easy. At that point, Davidson Creek is quite swift, thigh deep and filled with large, slick boulders. It is very easy to take the plunge; ask me, I know from experience!

Near the end of March 1998, John and I guided Hugh Nourse to the sweet spot to make photographs for this article. It was on this trip that I first met the impressive leaves of the orchid putty root (*Aplectrum hyemale*), growing in a wide flood plain. I hope we can return to see it in bloom later.

The road fords Davidson Creek in several locations. On certain trips, we wind up crossing it over ten times. On one of these crossings, I slipped on a rock. As I thrashed about and twisted around, trying to get my bal-

ance, my glasses popped out of my pocket and landed in the stream. I tried briefly and unsuccessfully to recover them and decided that the swift current must have carried them away. The muddy water prevented any hope of seeing them. Fortunately, Jim, already across, had seen them hit the water. He waded back in, reached down and came up with them. I am most grateful to Jim for a bit of magic.

On our recent trip, there were numerous groups of small pale blue butterflies (spring azure, *Celastrina argiolus pseudargiolus* f. *violacea*). On one occasion, hundreds of them flew up and surrounded us, circling like a tornado. It reminded me of the old Walt Disney features.

There are still unexplored areas along Davidson Creek. I feel certain that we will have other adventures in this rich area soon!

Photo from Hugh and Carol Nourse

Spring beauty

JG's Memoir

Spring beauties are special to me. I rather think that's because they live up to their name—they really are beauties. I've seen them growing in profusion as weeds in lawns in Rome, Georgia and Shreveport, Louisiana. I'm envious — with my lawn, I have to be satisfied with things like lesser chickweed, henbit and dandelion, except for the nice blue violets that come in spring and the wonderful ladies' tresses (*Spiranthes gracilis*) that bloom around the first of September.

Something else attracts me to spring beauties — I know of none in the wilds of Athens-Clarke County, Georgia, where I live, so I don't see them very often. *The Distribution of the Vascular Flora of Georgia*, by Sam Jones and Nancy Coile, shows clusters of *Claytonia virginica* in northwest, southwest and central Georgia, including Jasper, Putnam, Oglethorpe and Elbert Counties. The Georgia Botanical Society's *Atlas of the Vascular Flora of Georgia*, compiled by Marie B. Mellinger, gives a few more occurrences (mostly in the mountains, Hall County and the Atlanta area) but agrees that, except for Oglethorpe County, spring beauties are not found very near Clarke County.

Oglethorpe County is adjacent to Clarke, but the spring beauty site I know there is on the far side, away from Athens, at the Wilkes County line, where Wilbur Duncan found the Oglethorpe oak (*Quercus oglethorpensis*). It and sites in Jasper, Putnam, Elbert and Hall Counties are hour drives from Athens. So, for that

matter, are Panther and Davidson Creeks, Stephens and Habersham Counties, but these places are like home to me — we have a cabin close by on Lake Yonah, where we spend a few weeks each year. If spring beauties were there, I'd feel they were near.

Shortly after we got the cabin, my wife Edna spotted her trillium (*T. persistens*) growing along two tributary creeks to Yonah. Tracking this down with my friends George Neece and Wilbur led me to Panther and Davidson Creeks, where there are dolomite marble outcrops. Wilbur gave me copies of a geologic map of Panther and Davidson Creeks and a class field-trip species list. Spring beauties are not mentioned, even though they would be logical — they are calciphiles, and Panther and Davidson Creeks have calcium-rich areas. Neither are spring beauties mentioned in the species lists of G. W. McDowell and F. D. Snyder for Panther and Davidson Creeks (April 3, 1961), nor in James Graves' species list in his master's thesis, *A Comparison of Vegetation and Soils over Marble and Mylonite Parent Rock along Tributaries to Panther Creek, Stephens County, Ga.* (University of Georgia, Athens, 1979). For that matter, Edna and I trekked large areas of the bluffs and flood plain of Panther Creek many times between 1970 and the early '80s without noticing spring beauties. Notably, we saw none on the weekend of April 25-27, 1981, when I compiled a long species list.

One might think that all of this would be sufficient evidence of their absence; after all, they are not hard to see. Well, things don't work that way — negative evidence is inconclusive. In about 1982, I was casually poking around in some deep grass on the west bank of Panther Creek on the southern shoulder of the road that crosses it a little north of its junction with Davidson Creek. Nestled down in the grass was a lovely little flower that imprinted itself on my mind as a spring beauty.

I never saw it there again. By the time I tried to relocate it, the site had been destroyed by heavy equipment during the construction of a pipeline to provide Toccoa with emergency water from Yonah. (This same construction introduced kudzu to the area.) Later, as my memory faded, I came to be doubtful that I had ever seen it there. Maybe I had seen a wood anemone — maybe I just wasn't smart enough at that time to know the difference!

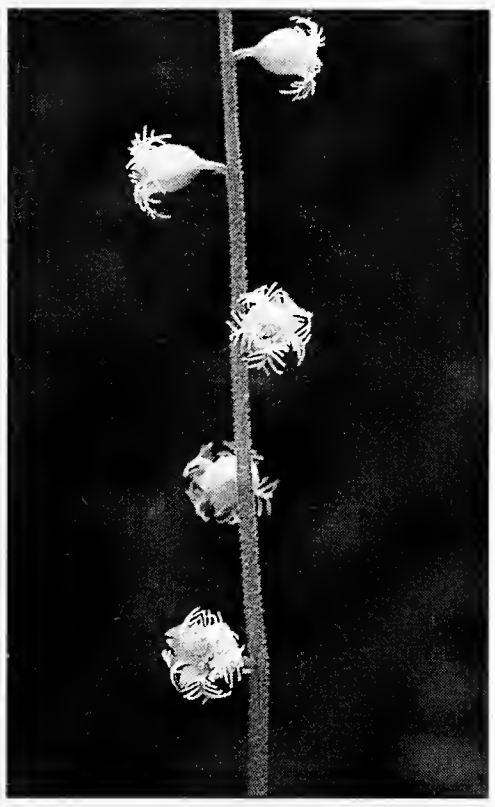
Probably in the early '80s, I met L. "Chick" Gaddy, then a graduate student at the University of Georgia. I asked him about the white, pedicillate trilliums that occur on Panther Creek, of which I had become suspicious. They were assigned to *T. erectum* on Wilbur's list, and in the marble ravines they are erect, but in nearby ravines they nod. Chick told me of a trillium expert, Thomas Patrick, then a graduate student at the University of Tennessee, and in no time I had arranged for Tom to come to the cabin for a weekend of field work in the Panther Creek area.

On Friday, April 18, 1986, Tom and his friend Rick managed to find us. Despite the facts that the trilliums in the marble ravines are erect, that many have white stamens and ovaries and that a rare plant has a red flower,

Tom used his nose ("green apples") to assign them all as the southern nodding trillium. In a letter of April 21, I commented on our having found ginseng (*Panax quinquefolius*), green dragon (*Arisaema dracontium*) and spring coral root (*Corallorhiza wisteriana*) on Panther Creek and on the great abundance of spring beauties that we had seen on Boatwright Creek, nearby in South Carolina.

On the weekend of April 20-22, 1990, I met Jim Sullivan – he was a speaker at the Annual Wildflower Pilgrimage of the Georgia Botanical Society at Toccoa. Jim and Sue lived on Little Leatherwood Creek, just south of Currahee Mountain, near Toccoa, where he had a backyard section of National Forest full of yellow lady's slippers (*Cypripedium calceolus*), grass-of-parnassus (*Parnassia asarifolia*) and other good things.

Photo from Hugh & Carol Nourse



Bishop's cap at Davidson Creek

We started going on field trips together. Jim, a first-class field botanist as well as fine wooden-canoe maker and effective ForestWatch leader, was studying southern flora – previously he had been most familiar with the northern mid-west.

Jim got hold of Pruitt's 1952 master's thesis on the geology of the Brevard Fault Zone along a section of Panther and Davidson Creeks, containing a large-scale map, the one Wilbur had given me earlier, showing marble outcrops. When Jim and Sue moved their home about three years ago to a location along the Tugalo River, just a couple of miles downstream from the mouth of Panther Creek, it became very convenient for him to explore the Panther-Davidson Creek area, which he has done. Sometimes I've gone with him.

I became obsessed with the occurrence of spring beauties in the area, and we started talking about them. Boatwright, Panther and Davidson Creeks are all Brevard Zone sites with underlying marble, and Boatwright and Panther/Davidson Creeks are opposite one another across the Tugalo River. If spring beauties are abundant on Boatwright Creek, why not on Panther Creek, which has similar marble-based soil and is only a mile away? I recalled my find, now uncertain on Panther Creek. As Jim failed to find them in his explorations, the occurrence of spring beauties there became more uncertain – my hazy memory of poking in the grass began to look bad indeed.

Davidson Creek commanded our attention immediately. Pruitt's map shows marble outcrops, and Wilbur had told me that he had been told that there were places there where the vegetation closely resembles that of the marble ravines of Panther Creek. McDowell and Snyder listed some unusual ferns from Davidson Creek, along with bishop's cap and green violet, both of which occur in the marble ravines of Panther Creek. Because parts of Davidson Creek are not easy

to explore, my forays there had been limited. They had also been uninteresting.

That changed dramatically when Jim reported finding speckled wood lily (*Clintonia umbellulata*), yellow mandarin (*Disporum lanuginosum*), fly poison (*Amianthium muscaetoxicum*) and yellow lady's-slippers on north-facing bluffs of Davidson Creek a few miles upstream from Panther Creek. The elevation, about 1000 feet, is unusually low for some of these species. My UGA chemistry colleague, Gary Newton, and I started more serious explorations downstream from Jim's site. On one foray, we carefully explored a region shown as marble on Pruitt's map without success — it was a dry mountain-side without much interest, except for a strange little canyon of a small branch, about 10 feet wide and up to 30 feet deep, with nearly vertical sides, containing Vasey's trillium and Indian cucumberroot (*Medeola virginiana*). The geologic map shows that much of this creek flows along a juncture between different bedrocks.

A little further upstream lay more marble on north-facing bluffs — formidable bluffs! We would have to walk along the road on the other side and, if we saw something promising across the creek, cross it to investigate. We put that off until another day.

That day turned out to be March 29, 1997. Gary and I met Jim at his home, laid our plans and drove to the point where I had poked in the grass. With all day ahead of us, I was resolved to explore that area, the land bounded by Panther and Davidson Creeks at, and a little upstream from, their juncture. There was nothing, of course, at the site that had suffered the destruction of construction, so I walked downstream along Panther (on my left) toward its junction with Davidson Creek (on my right). Within five minutes I was whooping with delight over a clump of spring beauties! We saw more after we turned upstream from the junction along Davidson Creek.

Now we set out for those formidable bluffs, dallying a little for Jim to satisfy himself that we weren't missing anything where Gary and I had already explored. After crossing the creek and heading upstream after the bend, the road veers away from the creek. Our poking around in the intervening woods revealed nothing spectacular, so we returned to the road. Eventually, we went down to the creek again, finding typical rich-woods plants on the way. At the creek, we had to boulder-hop.

A glance across the stream revealed a slight opening — the bluff appeared to recede from the bank. This was exciting. It was our first opportunity to go back across the creek to the north–facing bluff.

Crossing was not easy. Water rushed furiously over and between boulders in the creek bed. We took it slowly, testing each step with a stick to determine depth and fighting constantly against being toppled by the current. When we had all made it, we turned toward the bluff.

Within a few feet we were surprised by one of the most beautiful sights I've ever seen. We call it the "sweet spot." A narrow channel foots the very steep ravine. No water was flowing in the

channel – instead there was a series of pools of crystal-clear water, three feet deep, lined with leaves (no mud), with boulders at the margins separating the pools and continuing up the ravine. Shafts of early-afternoon sunlight gave the whole area a wonderful glow. We stood there a few moments drinking it in.

Upon recovering, we looked around us. Spring beauties were everywhere. So were green violet, bishop's cap, southern nodding trillium, Canada violet (*Viola canadensis*) and downy yellow violet (*V. pubescens*), walking fern and a variety of other ferns, including, in abundance, one or more bladder ferns (*Cystopteris* spp.).

From Davidson Creek, McDowell reported in 1961 a bladder fern he identified tentatively as *C. bulbifera.* "A definite determination will await mature leaves. Am sure it is not *C. fragilis.*" Wilbur tells me that he found *C. bulbifera* in a marble (limestone) quarry off Davidson Creek, but the specimen seems to have disappeared—Lloyd Snyder's *Field Guide to the Ferns and Other Pteridophytes of Georgia* (1986) and the UGA herbarium have records of *C. bulbifera* from Floyd and Walker Counties only.

B. Eugene Wofford, in his *Guide to the Vascular Plants of the Blue Ridge* (1989), indicates that the only common *Cystopteris* in the Blue Ridge is *C. protrusa,* regarded before 1960 as a variety of *C. fragilis.* The identities of both McDowell's bladder fern and the one we saw in the sweet spot remain unknown to me. It seems likely that they are *C. protrusa,* which Lloyd reports from Stephens County and says prefers "calcareous or circumneutral soil," or *C. bulbifera.*

When I took Edna to the sweet spot the following weekend, things had changed. Evaporation had lowered the levels in the pools of water. The light wasn't the same. It was still lovely, but it had less impact on me than the previous week.

We were not surprised then to find delicate small-flowered yellow lady's-slipper with slippers as small as the tip of your little finger.

On the way there, I looked across the creek, saw something I thought unusual and waded over to check it out. It was true! Walking fern was growing on the trunk of a tree, a foot or so off the ground. I'd not seen that before, but Wofford says that it is found "occasionally on tree bases." Later, on another visit to the sweet spot, I saw another tree harboring walking fern.

On the way back to our car, I crossed to the south side of the creek at the first appearance of a chance to walk along the creek there. I found many of the sweet-spot plants, including bishop's cap, Canada violet and downy yellow violet, nodding trillium and bladder fern.

Later, while rummaging through old files, I came across a copy of my big list of Panther Creek species from 1981. At the end are addenda dated April 19, 1986, including "*Claytonia virginica.*" Evidently I have "known" since then that spring beauties are there. I still don't recall where I saw them then.

On a rugged section of Davidson Creek, there appears to be a waterfall in a canyon with very steep walls on both sides, which I have not explored. The frontage of the sweet spot on Davidson Creek is probably less than 100 yards, but it appears to go up and up and up. There are still mysteries—what's up there, what's in that really rugged section and what's on the bluffs near the junction with Panther Creek, where I first saw spring beauties?

JS's Memoir

My excursions into the Davidson Creek watershed have always been searches. The first was for waterfalls, but all that followed became searches for interesting plant communities. On the first search, a Georgia ForestWatch field trip, we wandered onto a rich slope where we started seeing abundant and robust purple stoneroot (*Collinsonia verticillata*), a good indicator of circumneutral soil. We were not surprised then to find delicate small-flowered yellow lady's-slipper (*Cypripedium calceolus* var. *parviflorum*) with slippers as small as the tip of your little finger. While searching the area for more lady's-slippers, many unexpected species were found: fly poison, speckled wood lily, yellow mandarin, ginseng and devil's bit (fairy wand, *Chamaelirium luteum*). We could have been in some rich cove at much higher elevation!

Davidson Creek, following the Brevard Fault, is a beautiful, tumbling stream from its headwaters to Panther Creek, interrupted only by the Toccoa water system reservoir. The watershed is steep, making exploration strenuous and sometimes dangerous. The Brevard Fault is the key ingredient for a botanical wonderland. A 1952 master's thesis in geology by R. Pruitt, mapping the surface geology of the watershed, shows the same dolomite marble outcropping in the Davidson Creek watershed as occurs in the rich Radford Ravines of lower Panther Creek.

On our next ForestWatch excursion, we explored the north side of the creek, opposite the first site. A rich colluvial flat separates the creek from the toe of the south aspect slope. The overstory of hardwoods and hemlock shelters patches of wood betony (lousewort, *Pedicularis canadensis*), creeping phlox (*Phlox stolonifera*) and showy orchis (*Galearis spectabilis*). Two stemmed violets, American dog violet (*Viola conspersa*) and pale violet (*V. striata*), are also there. We finished that day by crossing the creek and climbing up a steep north-aspect slope for which we had high hopes of more rich spots. It turned out to be a disappointing mountain laurel thicket from bottom to top, forcing us to travel on hands and knees most of the way. On the way down the other side of the ridge, we stopped at a wonderful waterfall on the tributary called Friar Branch. Stopping to catch our breath in the cool spray we noticed grass-of-parnassus among the ledges.

I could not seem to stay away from the place and found myself wandering into the watershed on my way home from work, on my way to work and even sometimes when I should have been working but couldn't resist the temptation. The south rim of

the watershed is a razor-backed ridge, and it was the next place that drew my attention. I was hoping to walk out along it and descend the steep north aspect slopes downstream of the reservoir. It turned out to be a dangerous adventure. A plunge through the thickets often ended abruptly at the top of a precipice.

Learning that it would be better to explore that slope from the bottom up, I turned my attention to the ridge top itself. It is dominated by Table Mountain pine (*Pinus pungens*). This Appalachian endemic reaches the southern extreme of its range here. Its cones are serotinous, needing the heat of fire to cause them to open and shed seeds. Table Mountain pine is in decline in many areas because fire suppression has been so successful that young trees are not present in the understory when old cone-bearing trees succumb to disease, insects or storm. On this remote ridge, however, lightning struck an old dead snag, and the fire went unnoticed until the rain put it out. The result is a thicket of Table Mountain pine saplings! Found among the pines on the ridge is chinquapin (*Castanea pumila*).

Another search originated with a conversation with Tom Patrick, botanist for the Georgia Natural Heritage Program. Tom confirmed that a collection of southern maidenhair fern (*Adiantum capillus-veneris*) had been made near the headwaters of Davidson Creek. This fern is more common in the limestone sink region in southwestern Georgia. At this more northern site, there is an old lime kiln built into the slope on Walker Branch, where lime was derived from the native rock, most likely used in composing mortar for construction purposes. Explorations of the site by many folks, including Elmer Butler, a neighbor of the watershed, have been unsuccessful in relocating the fern.

Elmer found another surprise in the watershed, however. He called me one day after finding pink lady's-slipper (*C. acaule*). Preferring acid soils, pink lady's-slipper was an unlikely find at Davidson Creek. The pink lady's-slippers are found only a few hundred feet from the small yellow lady's-slipper population that thrives on circumneutral soils derived

Photo from Hugh and Carol Nourse

Walking fern on a tree at Davidson Creek

from the limestone/marble rocks. This points out the complexity of the soil environments in the watershed.

Moving downstream in our explorations, a Georgia ForestWatch group soon went around the reservoir to look at the north aspect bluffs that crowd the creek downstream. Here we found four ferns of limited distribution in the area. Walking fern covered mossy marble boulders on the steep slope. A drier, more exposed outcrop near the reservoir hosts black-stemmed spleenwort (*Asplenium resiliens*). Glade fern (*Diplazium pycnocarpon*) and silvery glade fern (*Deparia acrostichoides*) grow in the circumneutral soils of the lower slopes. Other plants we had been expecting to find somewhere in the watershed are abundant here, including doll's eyes (*Actea pachypoda*) and blue cohosh (*Caulophyllum thalictroides*). Among the stands of hemlock on the slope we found more showy orchis.

About this time, John Garst started telling me about the exciting species I hadn't found yet. He had a list of Davidson Creek plants by G. W. McDowell from 1961. It included some of the species found in the Radford ravines downstream on Panther Creek. There had to be another very rich site on Davidson Creek.

John also wished to locate spring beauty on Panther and Davidson Creeks. Frustrated by many unsuccessful attempts to find it, John had been wondering if he had imagined or dreamed its being there. With Gary Newton, we went up the watershed from the mouth of the creek in the spring of 1997. Gary and John had been exploring there earlier and had found no exciting spots. We knew we had to get further upstream.

As we started, John had to look for spring beauties one more time. We found them this time in the woods between the big field and the creek at the junction of Davidson and Panther Creeks. They were not abundant, and it was easy to see how they could have been missed. The day was off to a good start!

We poked around on some slopes as we worked our way upstream, finding pretty forests but no rich circumneutral sites. Along the way, we forded the creek more times then I can recall; it would be a wet day, but warm. There were patches of toothwort (*Dentaria diphylla*) on flat, moist ground near the creek. Most had a white butterfly with orange wing tips fluttering over them. This turned out to be falcate orange tip (*Anthocaris genutia*), whose preferred food plants are in the mustard family, as is toothwort.

As we moved upstream, there was a stretch of north aspect slope to explore before we got into areas where we had been before. This had to be it! Before we launched ourselves down the slope from the road to cross the creek again, we noticed a clump of one-flowered cancer root ("one-eyed" to Gary and John, they say; *Orobanche uniflora*), a plant without chlorophyll, living as a parasite on the roots of other plants. Across the creek, the slope was a rich carpet of green. Cobble-sized marble rock covered the slope amid larger boulders and several outcrops within our view. This substrate supports mosses, ferns, herbs and a broad-leaved sedge, *Carex*

plantaginea. Most of the plants we had been looking for are there in abundance.

Almost the entire Davidson Creek watershed is in the Chattahoochee/ Oconee National Forest. Considering the wide dispersal of rich botanical sites, the entire watershed needs protection from all but natural disturbances. Together, the Panther and Davidson Creek watersheds present an opportunity to have a large, undeveloped, botanically rich, unique natural area in a region that is experiencing rapid residential development. It would also create an important link between the Tallulah Gorge Natural Heritage Park to the north and the rich Brasstown Creek watershed across the Tugalo River in South Carolina, all of which are part of the Tugalo Mosaic that we described earlier in this journal (Tipularia 1993).

If you visit this marvelous watershed to enjoy the botanical diversity, remember to tread lightly and with great care. The slopes are steep, wet, fragile and easily disturbed. You should let the U. S. Forest Service, managers of the watershed, know that protection of these places is important to you!

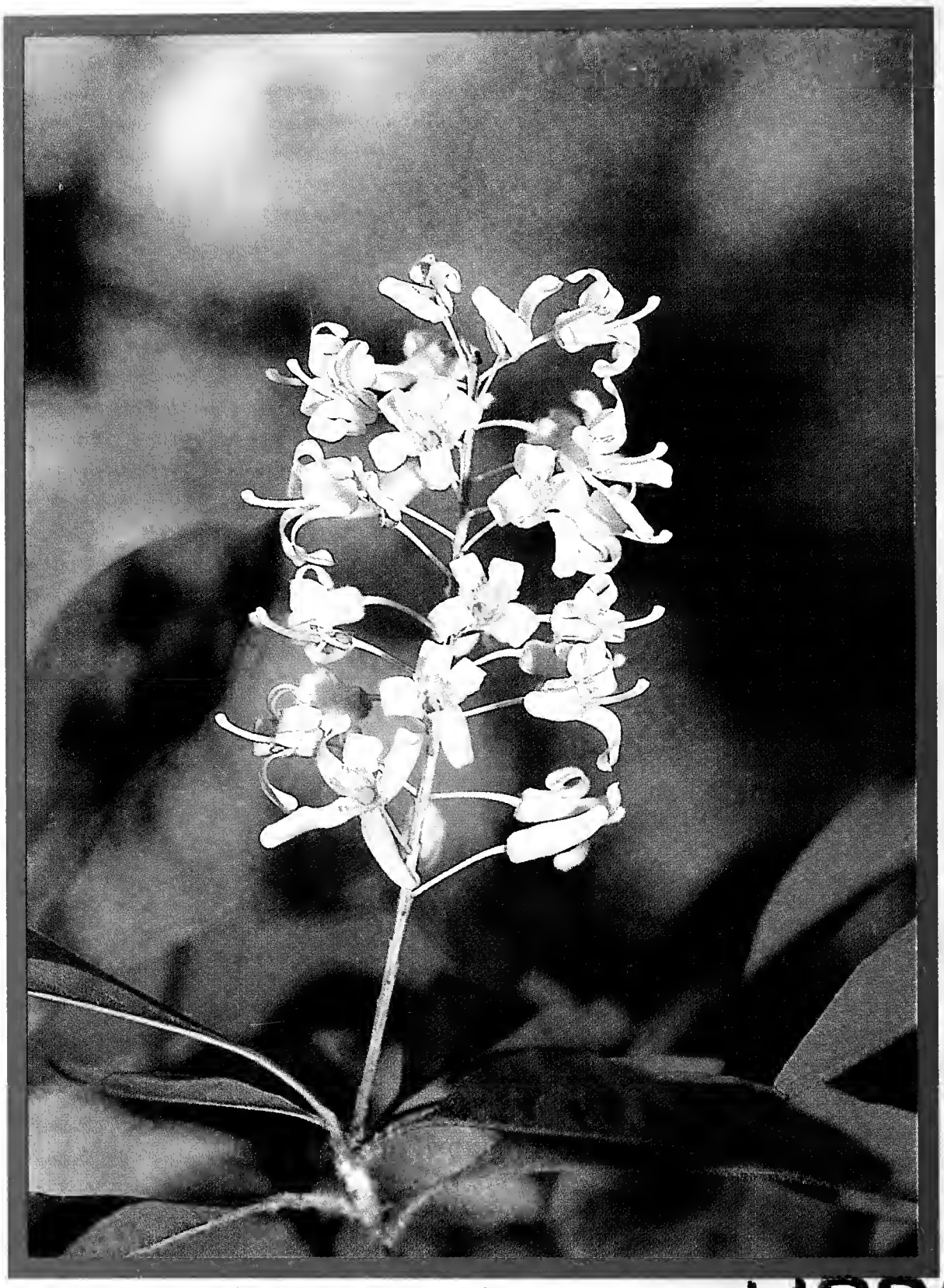
Byliners continued

Gary Newton, Ph.D., is Professor of Chemistry at the University of Georgia. His primary academic pursuits are organic chemistry and structure determination using single crystal x-ray diffraction. His interest in wildflowers was initiated by chemistry colleague John Garst about seven years ago.

Frankie Snow is a biology graduate of Georgia Southern College. He has spent decades studying the natural history of central South Georgia with emphasis on its prehistoric cultures and its flora. Since 1980 he has been teaching at South Georgia College.

James Sullivan is a boatbuilder, a perpetual student of forest ecosystems and a public lands activist. He lives in Stephens County near Davidson Creek.

Richard T. Ware, Sr., vice-president of the Georgia Botanical Society, has discovered several plants new to the state and has collected more than 200 specimens from Floyd County for the UGA Herbarium. He has published the *Checklist of the Vascular Plants of Floyd County, Georgia.*



Photograph from Hugh and Carol Nourse

Elliottia racemosa, Georgia plume

Tipularia

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